

A STUDY ON DIFFERENT CHEMICAL TREATMENTS FOR NATURAL FIBER REINFORCED COMPOSITES

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ABSTRACT

This paper examines the chemical treatments of natural fiber reinforced composites to increase their performance. The natural fibers have the advantages of low density, low cost, and biodegradability or eco-friendly in nature. But, the main disadvantages of natural fiber composites are the poor compatibility between reinforcement and matrix. In the natural fibers the relative moisture sorption is high compared to others. Therefore, in this paper the chemical treatments are compared with respect to their compatibility.

KEYWORDS: Chemical Treatment, Matrix, Reinforcement & Natural Fibers

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INTRODUCTION

Composite including no under two materials that have grouped characteristics, where one fills in as a fasten material moreover, trade as a fiber. The properties of the composites are solid, lightweight, breaking down safe, wear safe, and taking part in appearance. Different composites have been made with different sorts of constructed strands keeping in mind the end goal to enhance the mechanical properties. Beginning at now, the sort of composite tends to change from composite with fabricated strands to typical filaments. This is by temperance of the composite with fabricated filaments, for example, glass strands are not earth kind, incite issues of waste glass fiber, which can't be crumbled by nature [1]. Composites with standard filaments have different colossal motivations behind excitement over composites with delivered strands, for example, immaterial effort, lighter weight, open in the sort of plants or waste, non-lethality, and does not cause skin irritating [2]. The comfort of these composites lies in how the fixings are gotten satisfactorily from normal or common squanders and in this way the composites can be made relative effortlessly. Trademark filaments can be created with the target that its accessibility is sensible. In any case, typical strands in addition have different insufficiencies, for example, sporadic estimations, cemented, powerless to warm, simple to ingest water, and rapidly old. In a perfect world composite materials utilized as a bit of structures where quality to weight degree into thought [3]. Endeavors have been made to utilize standard fiber composites in non-associate application.

The following are the types of fibers

- Plant fibers
- Animal fibers
- Mineral fibers

Plant Fibers

Plant strands are for a huge amount of assignment contains cellulose: traces cotton, flax, jute, ramie, sisal and hemp. Cellulose fibers are ordered as a task of the accomplish of cardboard and material. The part of these strands is as demography after: Berry fibers are the strands access from the berry case and berry e. g. kapok and cotton. Leaf fibers are the strands get from the leaves e. g. agave and sisal. Derma fibers are the strands are get from the derma including the rotate of the plant. This fiber enduring school movement than changed fibers. In like way, these strands are instituted as a conveyance of solid yarn, surface, bundling, and paper [4].

Animal Fibers

Animal fibers for an extensive measure of assignment includes proteins; plots mohair, fleece, silk, and alpaca. Animal hairs are the strands got from animals e. g. horse hair, Sheep's wool, goat hair, alpaca hair, and so on. Silk fibers are the strands add up to from burned arrival of appalling crawlies for the span of the period of address of spreads [5].

Mineral Fibers

Mineral fibers are the regularly happening fiber or scarcely balanced fibers access from minerals. It has balanced courses of action they are taking after: Asbestos is the capital a significant part of the time incident mineral fiber. The Variations in mineral strands are the anthophyllite, amphiboles and serpentine. The Ceramic fibers are aluminum oxide, glass strands, boron carbide and silicon carbide [6].

Classification of Natural Fibers

The classification are as shown in the bellow [6].

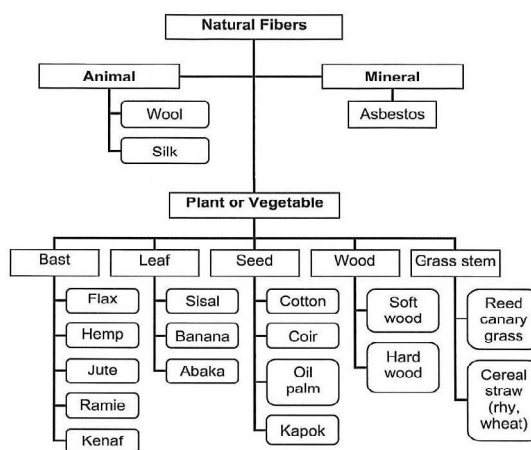


Figure 1

TYPES OF COMPOSITES

Metal Matrix Composites (MMCs)

Metal matrix composites, as the name proposes, have a metal framework. Occurrences of cross sections in such composites join aluminum, magnesium and titanium. The regular fiber joins carbon and silicon carbide. Metals are basically propped to suit the necessities of plan. For instance, the versatile steadiness and nature of metals can be broadened, while wide co-convincing of warm progression, and warm and electrical conductivities of metals can be diminished by the expansion of strands, for example, silicon carbide [7].

Ceramic Matrix Composites (CMCs)

Ceramic system composites have dirt matrix, for instance, alumina, calcium, aluminum silicate sustained by silicon carbide. The advantages of CMC fuse excellent, hardness, high organization temperature limits for stoneware, invention inertia and low thickness. Regularly impenetrable to high temperature, ceramic materials tend to twist up evidently delicate and to break. Composites viably made with let go systems are fortified with silicon carbide strands. These composites offer a comparable high temperature versatility of super mixes yet without such a high thickness. The delicate thought of pottery creation makes composite fabricate troublesome. For the most part most CMC age systems incorporate starting materials in powder outline. There are four classes of ceramics systems: glass (easy to make in light of low softening temperatures, fuse borosilicate and aluminum silicates), conventional pottery generation (silicon carbide, silicon nitride, aluminum oxide and zirconium oxide are totally crystalline), bond and established carbon parts [8].

Polymer Matrix Composites (PMCs)

The most generally perceived moved composites are polymer matrix composites. These composites contain a polymer thermoplastic or thermosetting invigorated by fiber (general carbon or boron). These materials can be framed into an arrangement of shapes and sizes. They give amazing quality and strength close by impenetrability to utilization. The clarification behind these being most essential is their insignificant exertion, high caliber and clear gathering models. Due to the low thickness of the constituents the polymer composites consistently show extraordinary specific properties [9].

CHEMICAL TREATMENTS

There are different classifications of chemical treatments

- Alkali treatment
- Silane treatment
- Acetylation treatment
- Benzoylation treatment
- Acrylation treatment
- Maleated Coupling Agents treatment
- Isocyanates treatment
- Permanganate treatment

The chemical treatment of fiber went for enhancing the grip between the fiber surface and the polymer network may adjust the fiber surface as well as increment fiber quality. Water assimilation of composites is lessened and their mechanical properties are progressed.

Alkaline Treatment Procedure

Alkaline treatment or mercerization is a champion among the most used compound treatment of trademark strands when used to reinforce thermoplastics and thermosets. The crucial change done by solvent treatment is the interference of hydrogen holding in the framework structure, in this way growing surface offensiveness. This treatment empties a

particular measure of lignin, wax and oils covering the external surface of the fiber cell divider, depolymerizes cellulose and revealed the short length crystallites. Expansion of liquid sodium hydroxide (NaOH) to normal fiber propels the ionization of the hydroxyl social event to the alkoxide.

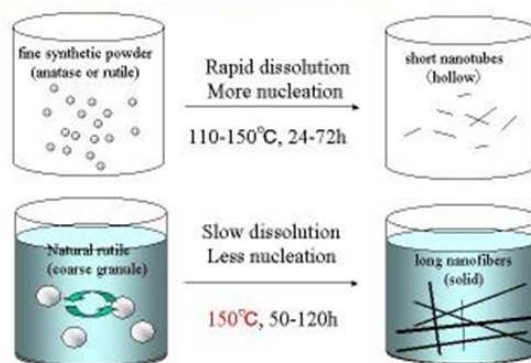
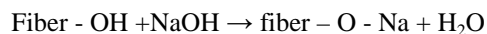
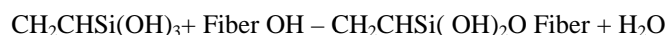


Figure 2

Silane Treatment

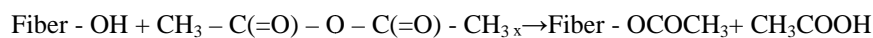
Silane is a substance compound with concoction condition SiH_4 . Silanes are used as coupling administrators to let glass strands hold fast to a polymer grid, balancing out the composite material. Silane coupling operators may diminish the amount of cellulose hydroxyl bundles in the fiber– organize interface. Inside seeing soggy, hydrolyzable alkoxy store up prompts the course of action of silanols. The silanol by then reacts with the hydroxyl social occasion of the fiber, molding stable covalent bonds to the telephone divider that are chemisorbed onto the fiber surface. Therefore, the hydrocarbon chains gave by the utilization of silane control the swelling of the fiber by making a cross linked compose on account of covalent holding between the grid and the fiber.

The reaction plans are given as follows:



Acetylation of Natural Fibers

Acetylation depicts a response presenting an acetyl practical gathering ($\text{CH}_3\text{COO}-$) into a natural compound. Acetylation of regular filaments is a notable esterification technique causing plasticization of cellulosic strands. The response includes the age of acidic corrosive (CH_3COOH) as side-effect which must be expelled from the lignocellulosic material before the fiber is utilized. Compound change with acidic anhydride ($\text{CH}_3-\text{C}(=\text{O})-\text{O}-\text{C}(=\text{O})-\text{CH}_3$) substitutes the polymer hydroxyl gatherings of the phone divider with acetyl gatherings, adjusting the properties of these polymers so they wind up hydrophobic. The response of acidic anhydride with fiber [11].



Benzoylation Treatment

Benzoylation Treatment is a basic change in normal association [11]. Benzoyl chloride is frequently used as a piece of fiber treatment. Benzoyl chloride fuses benzoyl ($\text{C}_6\text{H}_5\text{C}=\text{O}$) which is credited to the decreased hydrophilic nature

of the treated fiber and upgraded cooperation with the hydrophobic PS arrange. It was watched that the warm strength of treated composites were higher than that of untreated fiber composites. A near methodology was also associated by Wang [12] to upgrade the interfacial hold of flax fiber and polyethylene (PE) arrange. The fiber was at first stomach settling agent pre-treated remembering the ultimate objective to start the hydroxyl social affairs of the cellulose and lignin in the fiber; by then the fiber was suspended in 10% NaOH and benzoyl chloride respond in due order regarding 15 min. The secluded filaments were then assimilated ethanol for 1 h to remove the benzoyl chloride ultimately was washed with water and dried in the broiler at 80°C for 24 h. 5 Acrylation and Acrylonitrile Grafting, Benzoylation Treatment is a basic change in regular association [11]. Benzoyl chloride is routinely used as a piece of fiber treatment. Benzoyl chloride fuses benzoyl ($C_6H_5C=O$) which is credited to the lessened hydrophilic nature of the treated fiber and improved coordinated effort with the hydrophobic PS organize.

Permanganate Treatment

Permanganate is an exacerbate that contains permanganate assemble MnO_4 . Permanganate treatment prompts the advancement of cellulose radical through MnO_3 – molecule game plan. By then, profoundly responded Mn^{3+} particles are accountable for beginning association copolymerization as showed up underneath [26]: Most permanganate prescriptions are coordinated by using potassium permanganate ($KMnO_4$) course of action (in $CH_3)_2CO$) in different obsessions with soaking range from 1 to 3 min after essential pre-treatment [27-32]. Dunked alkaline treated sisal fibers in permanganate course of action at groupings of 0.033, 0.0625 and 0.125% in $CH_3)_2CO$ for 1 min [33].

Peroxide Treatment

In common science, peroxide is a specific utilitarian social affair or a molecule with the valuable get-together $ROOR$ containing the divalent molecule $O-O$. Normal peroxides tend to separate easily to free radicals of the edge RO ; RO by then reacts with the hydrogen social occasion of the matrix and cellulose strands. In peroxide treatment, strands are secured with BP or DCP in $CH_3)_2CO$ respond in due order regarding around 30 min after dissolvable base pre-treatment [34, 35]. Peroxide course of action center was 6% [36] and drenched game plans of peroxide in $CH_3)_2CO$ were used [37, 39]. Watched that high temperature was favored for the breaking down of the peroxide; peroxide-treated oil palm fiber-strengthened PF composites could withstand flexible stress to a higher strain level [40]. Investigated BP and DCP treatment on short sisal fiber strengthened PE composites [41-43].

Isocyanate Treatment

An isocyanate is a treatment containing the isocyanate functional amass – $N=C=O$, which is significantly vulnerable to respond with the hydroxyl gatherings of cellulose and lignin in strands. Isocyanate is represented to fill in as a coupling master used as a piece of fiber-strengthened composites [44]. The response between phenyl isocyanate (C_6H_5NCO) and surface carboxyl and phenolic capacities. CTDIC was set up through cardanol and toluene-2, 4-diisocyanate (TDIC) and formed one free isocyanate assemble for encourage reaction. It was displayed that CTDIC diminished the hydrophilic thought of the sisal fiber, thusly enhancing the pliant properties of the sisal fiber– LDPE composites. Pineapple leaf fiber with polymethylene-polyphenyl-isocyanate ($C_{15}H_{10}N_2O_2$) plan at 50°C for 30 min to improve the fiber– system interfacial connection. Taking a gander at silane and isocyanate-treated wood fiber– PS composites, it was represented that isocyanate treatment was more suitable than silane treatment in overhauling the mechanical properties of cellulose fiber– PS composites.

Other Chemical Treatments

Stearic corrosive ($\text{CH}_3(\text{CH}_2)_{16}\text{COOH}$) in ethyl alcohol arrangement was investigated in fiber treatment. It was represented that this treatment ousted non-crystalline constituents of the strands, thusly changing the fiber surface geography. Flax filaments medicines were more crystalline than the untreated ones and steartion lessened the fiber surface free essentialness. Sodium chlorite (NaClO_2) generally is used as a piece of fading strands nevertheless, it could delignify lingo cellulosics. Studies have been driven wherein it was used as a piece of fiber surface treatment for composites. Dove untreated sisal fiber, for use in sisal–PS biocomposites, in sodium chlorite [48 - 50].

Table 1: Chemical Treatments on Different Natural Fibers

S.No	Natural Fiber	Alkaline Treatment	Silane	Acetylation	Benzoylation	Permanganate	Peroxide	isocyanate	Acrylation	Maleated Coupling
1.	Cotton	YES					YES			
2.	Jute	YES								
3.	Flax	YES			YES					
4.	Hemp									YES
5.	Ramie	YES	YES				YES			
6.	Sisal	YES	YES	YES	YES	YES	YES	YES	YES	YES
7.	Coir	YES								
8.	Softwood							YES		
9.	E-Glass								YES	
10.	S-Glass								YES	
11.	Carbon							YES		

CONCLUSIONS

- Natural filaments are considered as potential swap for man-made fibers in composite materials. Chemical treatments can build the interface adhesion between the fiber and matrix.
- All the chemical treatments are clarified for any natural fibers with their application.
- Any natural fiber can be dealt with by any treatment for improve their properties.
- Therefore the chemical treatments can be considered in changing the properties of natural fibers. Most chemical treatments have made different levels of progress in changing the fiber strength.

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